

But the sections given by Gardner for the Arroyo Torrejon and Rio Puerco areas are certainly much too thin. As shown by his map, photograph, and sections, he interpreted the Ojo Alamo sandstone in the vicinity of the Rio Puerco as a sandstone in the lower part of the Puerco formation, and he included in the Puerco the beds below the Ojo Alamo and down to the Lewis shale. These beds are now known to include Kirtland shale, Fruitland formation, and Pictured Cliffs sandstone. If from the Rio Puerco section given by Gardner 281 feet of beds at the top which are probably to be referred to the Wasatch and 179 feet of Ojo Alamo and older Cretaceous beds at the base are excluded there remains 379 feet for the combined thickness of the Puerco and Torrejon formations. The thickness of the Puerco and Torrejon formations at this place however, is actually more than 630 feet as is shown by the section in Table 1.

Gardner correlated the fourth member above the base in his Rio Puerco section (now known to be Ojo Alamo sandstone) with the third member above the base in his Arroyo Torrejon section, a 30 foot tan colored sandstone, and stated that this is a very persistent horizon marker and was traced continuously from the Nacimiento Mountains to the Arroyo Torrejon and beyond. This 30-foot tan-colored sandstone is quite surely Ojo Alamo and the 80 feet of shale below it is Kirtland shale. Accordingly Gardner's Arroyo Torrejon section allows only 240 feet for the combined thickness of the Puerco and Torrejon formations. An estimate by the writer, based on known contact elevations and locations and a minimum allowance for dip of 1 foot per 100 horizontally, gives a thickness, believed to be conservative, of 700 feet for the combined Puerco and Torrejon formations in the vicinity of Arroyo Torrejon. This does not seem excessive compared with the incomplete section of 570 feet of Puerco and Torrejon measured at the head of Ojo Alamo Arroyo, in T. 24 N., R. 11 W., by C. M. Bauer and J. B. Reeside, Jr.¹³

Sinclair and Granger¹⁴ in correlating their sections with the sections published by Gardner state that "In the Arroyo Torrejon section of Gardner the full thickness of the Puerco is certainly not exposed. Of the 210 feet referred by him to that formation 100 feet is now known to belong to the Torrejon because Torrejon fossils in abundance are found at the point indicated in the section, 100 feet below his Puerco-Torrejon contact." The point indicated in the section is just above the 30-foot tan-colored sandstone which is most probably the Ojo Alamo sand-

¹³ J. B. REESIDE, JR. *op. cit.* 67.

¹⁴ W. J. SINCLAIR and WALTER GRANGER. *op. cit.* 308.

stone. Furthermore, on the same page they speak of "the discovery of Torrejon fossils immediately above the 30 foot bed of sandstone (third member above the base in the Arroyo Torrejon section)." If these correlations were accepted, the Puerco would be missing from

TABLE 1—SECTION OF PUERCO (?) AND TORREJON FORMATIONS, EXPOSED IN THE FRONT OF CUBA MESA, IN THE NORTHEASTERN PART OF T. 20 N., R. 2 W.
MEASURED BY C. B. HUNT.

	Feet	Inches
Wasatch formation:		
Sandstone and conglomerate		
Puerco (?) and Torrejon formations:		
Sandstone, argillaceous, tan	70	
Sandstone, light tan	12	
Sandstone, argillaceous, tan in lower part, gray above	48	
Clay, in alternating light and very dark gray bands	30	
Sandstone, gray, massive and cross bedded	12	
Clay, in alternating light and very dark gray bands	29	
Sandstone, tan, cross bedded	14	
Clay, sandy, gray, with some bands of dark gray clay	20	
Sandstone, gray, cross bedded	18	
Clay, in alternating bands of variable thickness, light and very dark gray	12	
Sandstone, gray, cross bedded	32	
Clay, in alternating bands of light and very dark gray	36	
Sandstone, gray, cross bedded	10	
Sandstone, with spheroidal concretions of dark manganiferous (?) material, more than a foot in diameter	3	
Sandstone, gray, cross bedded	10	
Clay, in alternating light and dark gray bands	70	
Sandstone, fine grained, light gray, with dark manganiferous (?) concretions	18	
Clay, in alternating light and dark gray bands	24	
Sandstone, fine grained, light gray	5	
Clay, in alternating light and dark gray bands, white at the base	26	
Coal	0	2
Clay, banded light and dark gray	15	
Shale, dark carbonaceous, not a persistent bed	0	6
Coal, a bed locally as much as one foot thick and continuous for three quarters of a mile	0	8
Clay, dark gray with some lighter gray bands	18	
Sandstone, fine grained light gray, of variable thickness	7	
Clay, light and dark in alternating bands	43	
Concealed for the most part but probably banded clay	50	
Thickness of Puerco (?) and Torrejon	633	4
Ojo Alamo sandstone:		
Sandstone and conglomerate		

Arroyo Torrejon eastward. It appears, however, that Sinclair and Granger were misled by the erroneously thin section given by Gardner into believing that the lower fossil horizon, 100 feet below the upper one, would fall just above the 30 foot sandstone (now recognized to be

the Ojo Alamo). However, they further state that the two Torrejon fossil horizons are exactly 100 feet apart and that both horizons were traced from the East Fork of Arroyo Torrejon to the west branch of Kimbetoh Arroyo. Inasmuch as the Arroyo Torrejon collecting localities located on their sketch map and described in their text are in the face of the cliff capped by the basal sandstone of the Wasatch it appears most likely to the writer that both Torrejon horizons are actually well above the Ojo Alamo sandstone.

Accordingly the writer believes that in the Arroyo Torrejon section there are probably 450 feet of beds below the lowest Torrejon fossils, in which quite possibly there are beds equivalent to the Puerco beds farther west. Because the combined thickness of beds of Puerco and Torrejon lithology along the Rio Puerco is less than 100 feet thinner than the probable thickness of the Puerco and Torrejon formations on Arroyo Torrejon, it further appears that an equivalent of the Puerco formation may also be present along the Rio Puerco.

PALEONTOLOGY.—*Fossil Pinnotherids from the California Miocene.*¹

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Mr. E. W. Galliher of the Hopkins Marine Station has sent to the National Museum a number of specimens of Pinnotherid crabs from the type locality of the Monterey formation at Pacific Grove, as follows:

Specimens 1–5, from the top of hill with elevation of 610 feet about 1 mile W. of N. of Loma Alta and stratigraphically 700 feet approximately above the base of the type section of the Monterey formation.

Specimens 6–9, 11, 12, from the top of Loma Alta (northerly peak) and stratigraphically about 1000–1300 feet above the base of the type section.

The specimens are embedded in Monterey shale of a pinkish cream color. The most abundant species, *Pinnixa galliheri*, varies in color from ochraceous buff to raw sienna; *Parapinnixa miocenica*, from ecru drab to bistre; while the single specimen of *Pinnixa montereyensis* is mummy brown.

Pinnixa galliheri, new species

Carapace in shape akin to *P. faba*,² the anterior margin advanced at middle, lateral margins arcuate, continuous with the antero-lateral curve; length a little more than $\frac{2}{3}$ of width; greatest width a little in advance of middle; surface finely and closely pitted or reticulate. Gastric region defined; mesogastric almost an equilateral triangle, a pit at each angle, a groove extending

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² M. J. RATHBUN. *A recent species, Alaska to San Pedro, California.* Bull. U. S. Nat. Mus., 97: 142, pl. 31, figs. 1–4, and synonymy. 1918.